

&XUU 3HGLDWU 5HV

,661  
ZZZ FXUUHQWSHGL

5HODWLRQ EHWZHHQ VHYHULW\ RI 1\$)/' DQG L  
FKLQGU

+ (O .KD\DOVR KDPHG 7+ 6600 D D P6 D OHDPEO ( (O .KRO\  
'HSDUWPHQW RI 3HGLDWULFV \$LQ 6KDPV 8QLYHUVLW\ &DLUR (J\ S  
'HSDUWPHQW RI &OLQLFDO 3DWKRORJ\ \$LQ 6KDPV 8QLYHUVLW\ &D

\$EVWUDFW

%DFNJURXQG :LWK LQFUHDVLQJ SUHYDOHQFH RI FKLOGKRRG REHV  
'LVHDV\$)/' EHFDPH WKH PRVW FRPPRQ FDXVH RI FKURQLF OLYHU G  
UHVLVWDQFH LV WKH PDLQ ULVN IDFWRU RI 1\$)/' 1\$)/' LV DV\PSWRP  
DQG WUHDWPHQW RI ULVN IDFWRU LV HVVHQWLDO LQ WUHDWPHQW D  
\$LP 7KLW VWXG\ ZDV GHVLJQHJ WR GHWHFW WKH UHODWLRQV KLS  
UHVLVWDQFH  
0HWKRGV 7KLW FURVV VHFWRUQDQV VWXG\ ZDV FRQGXFWHG RQ RE  
\HDUV ROG \$OO FKLOGUHQ ZHUH VXEMHFWHG WR IXOO PHGLFD  
PHDVXUHPHQWV LQFOXGLQJ ZHLJKW KHLJKW %0, ZDLW FLUFXP  
5DWLR :+5 :DLW WR +HLJKW 5DWLR :+W5 ERG\ FRPSRVLWLRQ  
IDVWLQJ JOXFRVH IDVWLQJ LQVXOLQ DQG +20\$ ,5 ZDV FDOFXODWHG  
5HVXOWV RI WKH VWXG\ JURXS ZDV PDOHV DQG ZHUH IHPDO  
VWHDWRVLV ZDV DQG JUDGH PRGHUWH VWHDWRVLV ZDV  
VWHDWRVLV KDG PRGHUWH LQVXOLQ UHVLVWDQFH DQG KDG V  
ZLWK JUDGH VWHDWRVLV KDYH VHYHUH LQVXOLQ UHVLVWDQFH  
VWDWLVWLFDOO\ VLJQLILFDQW DVVRFLDWLRQ ZLWK 1\$)/' JUDGH ZLW  
:+W5 ZDV KLJKO\ VWDWLVWLFDO VLJQLILFDQW DVVRFLDWHG ZLWK  
WKHUH ZDV D VWDWLVWLFDOO\ VLJQLILFDQW SRVLWLYH FRUHDWLV  
DQG +20\$ ,5 ,Q WKH VWXG\ JURXS WKHUH ZDV KLJKO\ SRVLWLYH V  
JUDGHV DQG IDVWLQJ LQVXOLQ OHYHO DQG +20\$ ,5 ZLWK S YDOXH  
FRUHDWLRQ EHWZHHQ 1\$)/' JUDGHV DQG IDVWLQJ JOXFRVH OHYHO  
&RQFOXVLRQ +20\$ ,5 KDV KLJKO\ VLJQLILFDQW UHODWLRQ ZLWK  
VWHDWRVLV E\ +20\$ ,5 FDOFXODWLRQ LV YHU\ LPSRUWDQW WR SUHY

.H\ZRUG\$)/' +20\$ ,5 :+5 :+W5

\$FFHSWHG RQ WK 'HF

,QWURGXFWLRQ ,QVXOLQ 5HVLVWDQFH ,5 LV D JURZ  
&FKLOGKRRG REHVLW\ EHFDPH D ZRUOGZLGH XSHUHQFH QRB REHVK SHRS  
FKLOGUHQ XQGHU ZRUOGZLGH ZHUH PRYHUZHJKW RU REHVKLQ OHWDERO  
DQG RYHU PLOOLRQ FKLOGUHQ DQG DGRVHYHQWV DHHG REHVLW\  
RYHUZHJKW RU REHVK LQ 2EHVLWLV FODWRILHG DFERUGLQJ WR  
HWLRORJLFDO IDFWRUV LQWR HQGRJHQRXV DQG HIRJHQRXV REHVLW\  
DERXW RI GLDJQRVHG FDVH RI REHVLW\ DUH HIRJHQRXV DQG  
RQO\ DUH HQGRJHQRXV > @ ,5 LV WKH IDLOXUH RI LQVXOLQ SRU  
JOXFRVH XSWDNH DQG WKH JOXFRVH  
(IRJHQRXV REHVLWLV FDXWDXG SURGXFWLRQ KLJK UHVXOWLQJ LQ KISH  
HQHUJ\ IRRG ZLWK DFNRYRWIS SXH SUDVH EHGWDU\ LQVXOLQ UHVLVWDQFH  
OLIHVW\OH LQFOXGLQJ VLVW ZDWRKLVDOO\ DGRVHYHQWV DHHG REHVLW\  
HQGRJHQRXV REHVLWLV FDXWDXG SURGXFWLRQ KLJK UHVXOWLQJ LQ KISH  
EH VXSHFWHG RU HGHVWUHQHG KELYWPNLQ DQG RI WKH UHODWLRQ EHV  
SKVLFDO H[DPLQDWLV RQGU@PHOHV FVRLV LQFUHDVHG DEGRPLQDO  
LQVXOLQ UHVLVWDQFH VDGZURPDGZLGHV RQVGHVHG LQVXOLQ UHVLVWDQFH  
HSLGHPLF ,W UHIHUV WR DDFORXW\ LQVXOLQ UHVLVWDQFH D KLJKHU FI  
LQFUHDVH ULVN RI &RURQDU\ FDXWDXG SURGXFWLRQ KLJK UHVXOWLQJ LQ KISH  
FDUGLRYDVFXODU DWKHURVFOHURWLF GLVHDVHV DQG GLDEHWHV PHOO  
W\SH > @



5HODWLRQ EHWZHHQ VHYHULW\ RI 1\$)/' DQG LQVXOLQ UHVLVWDQFH LG

WDSH ZDV ORFDWHG HYHQO\ DURXQG 500 VLVXORZLFV ODIW WKLVLSRDIWRQ  
5HDGKDG EHHQ WDNHQ WR WKH QHDUHVW PLOOLPHWHU DW WKH HOG RI  
QRUPDO H[SLUDWLRQ /LYHU XOWUDVRQRJUDSK\ VKRXOG EH

+LS FLUFXPIH[HOGUHQ ZHUH LQ D +LH[DUNGOVWDDQLSUREH 6WHDWRVLY  
SRVLWLRQ DQG WKHLU IHHW ZHUH WRHHWKHU@DQG WKH JOXWHDO PXVF  
ZDV UHOD[HG \$ IOH[LEOH WDSH ZDV XVHG WR PHDVXUH DW WKH OHYHO RI  
WKH JUHDWHU SRVWHULRU SURWXEHUDGSEFVFR\WKH EXWWRFNV ZKLFK  
FRUUHVSRRGV DQWHULRUO\ WR DERXW WKH OHYHO RI VPSKIVLV SXELV  
DURXQG WKH KLSV IURP WKH VLGH WKHGHVXELRIGWKWHWDSHV ZDV WKHOG JK  
WKH ULJKW KDQG ZKLOH WKH OHIW KDQGHQEMXDV WKHRMDSZLOKYEQRUPDO

:DLVW WR +LS 5DWWRJL:45V LGHD DERXW FHQWUDO DQG SRUWDQ YHLQ ERUGHUV  
GLVWULEXWLRQ RI IDW \$ :+5 RI \*URDG FRUGHU DW WLVJWLHDFRVLV DV PRG  
IHPDOHV DQG UDWLR RI RU PRUHLRUILODHFVFRKHV RZLW KOLPVDKWLQ  
RI :+5 LV WKH FKDQFH RI HUURU GXELVSKVLFNDQSVFRUWDQVYHQDQGERUGI  
ODUJH KLS ERQH LQ VRRPH SHRSOH ZKLEK OHDGV WR LOEUHDVHG KLS  
FLUFXPIHUHQFH > @ UDGH 6HYHU VWHWRVLY DV ILQH F

:DLVW WR +HLJKW 5DWLR :+W5 7KH SRUWLRQERHWKHLQJLDKWWORQ  
+HLJKW :+W5 ERWK PHDVXUHG LQ FHQWLPWHUHV ZDV FDOFXODWHG  
DQG D FXWRRI RI XVHG WR GLIHUHQVLFDVRSURVWDO IURP KLJK  
:+W5 > @ :+W5! LQGLFDWHV FHQWUDO REHVLW\ :+W5  
QRUPDO > @ \$Q LQIRUPHG FRQVHQW ZDV REWDLQ  
HQUROOPHQW LQ WKH VWXG\ DFFRUC  
SLQ VKDPV XQLYHUVLW\ UHVHDFK HV

*%RGI FRPSRVLWLRQ*

,W KDV EHHQ GRQH E\ 7DQLWD 6& 6ADVFDQWLZANQ DQDQVWHJUDO  
SULQWHU ZKLFK JLYHV DQ DFFXUDWH PHDVXUHPHQW DQG ERG\  
FRPSRVLWLRQ DQDO\VLV GDWD 7KH XVHUGHG QSDZRUHV WKH DQDQVWH  
IRU WKH KHDOWK DQG ILWQHVV IDFLOXUHDVPHQW \$KLYDQDQDQDQV  
RI WKH FOLHQW\ V NH\ PHDVXUHPHQW\ DSSHDQV LQ WKH ERWRPZRUHWR  
SULQW RXW JLYLQJ DQ LQVWDQW FRUWVWWRQ WRKRO\$QDQVLYV QDWE  
EH WUDQVIHUHG DXWRPDWLFDOO\ WR DSHRFRSHWHU ,W ZDV XVHG ZLWK  
7,\*021 KHDOWK PRQLWURU VRIWZDUH 7KH IROORZLQJ WHVWV ZHUH GRQH

7KH 6& ZDV DXWRPDWLFDOO\ VHW XS SHUHQSHUWRDQDQV SDWHHQW RI  
VWXGLHV FDSWXULQJ PHDVXUHPHQW WR PDQGLUHQWZHHVXQVZV LQDQV DUL  
RI UHSRUWLQJ IRUPDWV \$QDO\VLV LOFOXGHV ZHLJKW NJ OEV %0,  
ERG\ IDW ERG\ IDW PDVV IDW IUHQV\LVQVHEOHVFDVW WRWVGR JU  
ERG\ ZDWHU ERQH PDVV YLVFHUODSDUJPHWLVJGPWDEROLF DJH DQG  
EDVDO PHWDEROLF UDWH &KL VTXDUMHVW RI VLJQLILFDQFH ZI  
FRPSDUH SURSRUWLRQV EHWZHHQ TX

*/DERUDWRUI LQYHVWLJDWLRQV*

7KH PO RI YHQRXV EORRG ZDV FROOHFWHG IURP HXFKO SDWWHQW DQDQV  
FRQWUROV 7KH\ ZHUH DVNHG WR EH HDVWLQDQIRULQWFRUHDWKDQ KRUVF  
%ORRG VDP SOHV ZHUH DOORZHG WR VFRWRHULFFXUDQXMMKDDQVWKHFKL V  
FHQWULIXJHG IRU PLQXWHV DW QXPEDQDQMKVPEVDDXP ZDV  
FROOHFWHG

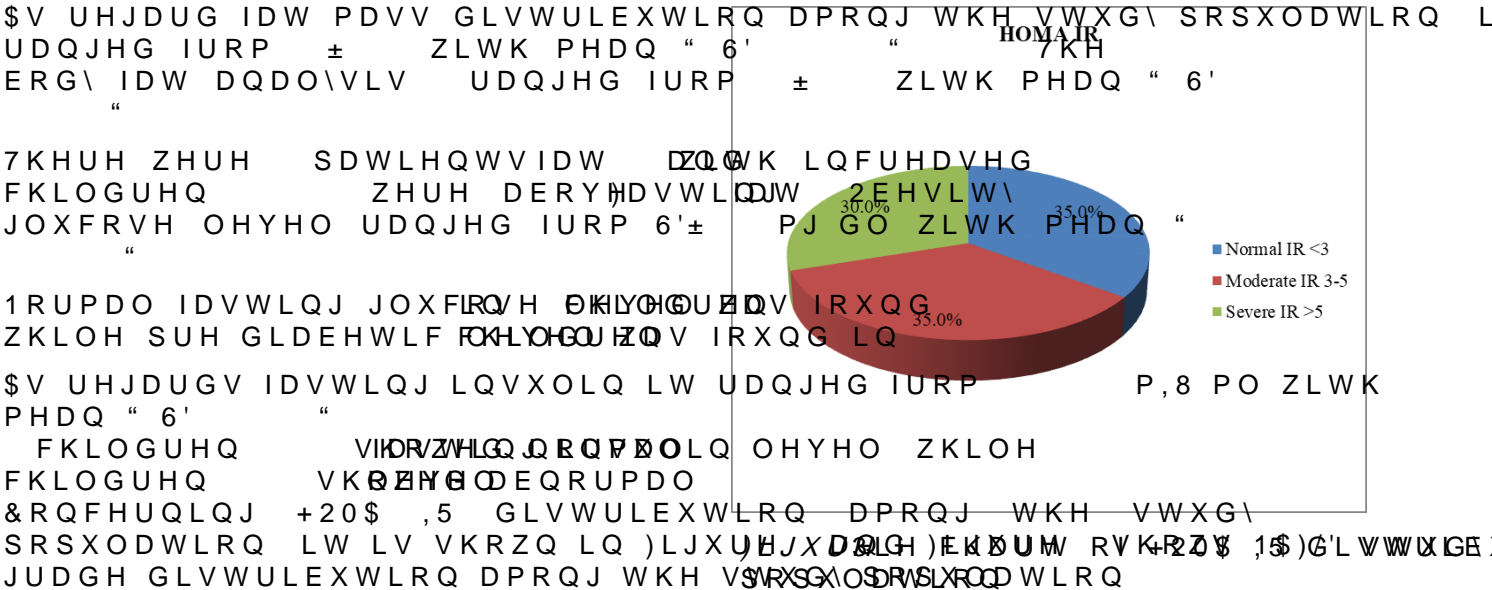
6SHDUPDQ V UDQN FRUUHODWLRQ FR  
)DVWLQJ EORRG JOXFRVH ZDV PHDVXUHGHVXUHQVWKH KRFRNDQDQVHEHWZ  
JOXFRVH (SKRVSKDWH GHK\GURJHQVDFVFRKHVFRKROZDVFNFDQV  
\$8 DXWRPDWHG DQDO\JHU %HFNDQ &RXOWHU +LDOHDK 86\$  
9DOXH RI 3U UDQJHV IURP WR

6HUXP LQVXOLQ ZDV PHDVXUHG E\ HOHFWRU EKHPLOXPLOHVHQFH  
PHWKRG \$9,\$ &HQWDXU &3 6LHPHQV SHUDDQ FRUUHODWLRQ SHU  
+20\$ ,5 DV D PDUNHU RI LQVXOLQ UHVLVWDQFH ZDV FDOFXODWHG E\  
WKH KRPHRVWDWLF PHWKRG XVLQJ VVWYH DQG IURP XODH WKH LQGHV  
FDOFXODWLRQ +20\$ , i \* > @ LQ WKH GHSHQG HQW YDULDEOH

1HJDWLYH ,QFUHDVH LQ WKH LQGSUSHQGHQW YVMDGDESRHSXODWLRQWLRQWURDQ
GHFUHDVH LQ WKH GHSHQGHQW PHDQ6' " FKLOGUHQ
6FDWVRW \$ JUDSK LQ ZKLFK WKH YDOXHV ELXWLRQYDULDEOHVZHUH \H
SORWWHG DORQJ WZR D\HV WKH SDWWHUWELXWLRQWKHUVYDULQJPDOS
UHYHDOLQJ FRUHHODWLRQ SUHVHQWZLWK SHUFHQW DJH DQG ZHUH IH
7KH FRQILGHQFH LQWHUYDO ZDV VHWPHDQ " 6DQG WKH PDUJLQRORZHU
DFFHSWHG ZDV VHW WR 6R WKFKLSGDH ZDVZFRQVLCMZHHQ WK
VLJQLILFDQW DV WKH IROORZLQJ ZHUH WK \$V IRU WKH ZHLJ
3UREDELOLW\ 3 YDOXH EHWZHHQ DQG ZLWK PHDQ " 6'
3 YDOXH ZDV FRQVLGHUHG VLJQLILFDQW 5HJDUGLQJ KHLJKW LW UDQJHG IURP
3 YDOXH ZDV FRQVLGHUHG DV KLKOGUHLQQLILFDQWZHUH EHWZHHQ V
3 YDOXH ! ZDV FRQVLGHUHG LQVLJQLILFDQW ZHUH EHWZHHQ WK WK F
5HVXOWV +HLJKW ] VFRUH UDQJHG EHWZHHQ
7RWDO QXPEHU RI WKH VWXG\ SRSXODWLRQ ZDV DQG WKH GLVFRUH D
LQWR WZR JURXS DFFRUGLQJ WKH JUDGH PHDQ " 6LYHU " FKLOGUHQ
KDG PLOG VWHWV \*UDGH &RQFHUQLQJ :FKLOGUHQW5 GLVWULE
KDG PRGHUWH VWHWV \*UDGH SRSXODWLRQ WKH DUH VKRZQ LQ 7D

WHR and WHtR		
WHR	Range	0.87–1.02
	Mean ± SD	0.94 ± 0.05
	Median	0.94
WHtR	Range	0.55-0.83
	Mean ± SD	0.66 ± 0.08
	Median	0.67

Table 1. WHR and WHtR distribution among the study population.



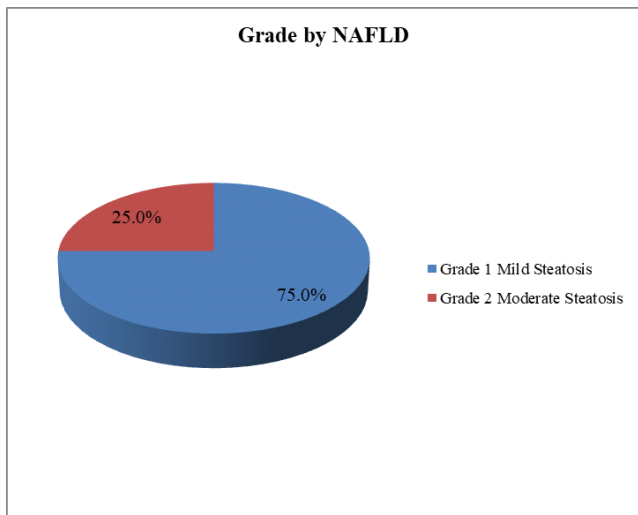


Figure 2. Pie chart of NAFLD grade distribution among the study population.

7KHUH ZDV QR VWDWLVLVWLFDO VLJQ  
1\$)/' JUDGH DQG DJH DQG VH[ RI WKH  
YDOXH !

\$OVR WKHUH ZDV QR VWDWLVLVWLFDO VLJQ  
EHWZHHQ 1\$)/' JUDGH DQG ZWWX\G\N  
SRSXODWLRQ ZLWK S YDOXH !

7KHUH ZDV VLJQLILFDQW DVVRFLDWL  
JUDGHV DQG: +20\$ ,5 ZLWK S YDOXH S  
LQ 7DEOH

There was no statistically significant association between NAFLD grades and body composition as regards fat mass and body fat analysis %, with p-value >0.05.

There was a statistically significant association between NAFLD grade and

		Grade 1 mild steatosis (n=15)	Grade 2 moderate steatosis (n=5)	t-test	p-value
WHR	Mean ± SD	0.91 ± 0.04	1.00 ± 0.03	-4.378	<0.001**
	Range	0.87-0.99	0.95-1.02		
WHtR	Mean ± SD	0.62 ± 0.05	0.77 ± 0.06	-5.388	<0.001**
	Range	0.55-0.69	0.71-0.83		

Table 2. Association between NAFLD grade and WHR and WHtR of the study population.

There was highly statistically significant positive correlation between WHR and WHtR with fasting insulin with p-value <0.001, and r-value 0.889 and 0.925 respectively. fasting insulin level with p-value 0.020. Moreover, there was a highly statistically significant association between NAFLD

JUDGH DQG +20\$ ,5 ZLWK S YDOXH  
KDQG DVVRFLDWLRQ EHWZHHQ IDVW  
JUDGHV ZDV QRQ VLJQLILFDQW ZLWK  
7DEOH

		Grade 1 Mild Steatosis (n=15)	Grade 2 Moderate Steatosis (n=5)	Test	p-value
Fasting glucose (mg/dl)	Normal 70-100	8 (53.3%)	1 (20.0%)	FE	0.194
	Pre diabetes 101-125	7 (46.7%)	4 (80.0%)		
Fasting insulin (mIU/ml)	Normal 1-15	9 (60.0%)	0 (0.0%)	FE	0.020*
	>15 Abnormal	6 (40.0%)	5 (100.0%)		
HOMA IR	Normal IR <3	7 (46.7%)	0 (0.0%)	FE=15.56	<0.001**
	Moderate IR 3-5	7 (46.7%)	0 (0.0%)		
	Severe >5	1 (6.7%)	5 (100.0%)		

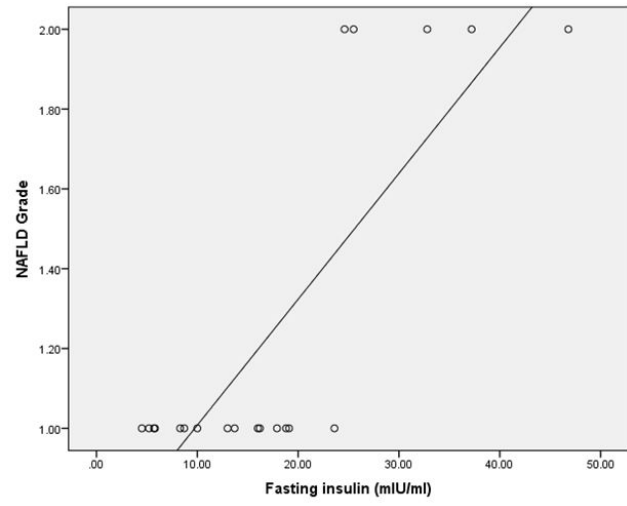
Table 3. Association between NAFLD grades and fasting glucose level (mg/dl), fasting insulin level (mIU/ml) and HOMA IR of the study population.

\$OVR WKHUHKLJKO\ VWDWLVLVWLFDO VLJQLILFDQW SRSXODWLRQ EHWZHHQ WHR and WHtR with HOMA IR, with p-value <0.001 and r-value 0.886 and 0.925 respectively. DQG U YDOXH .

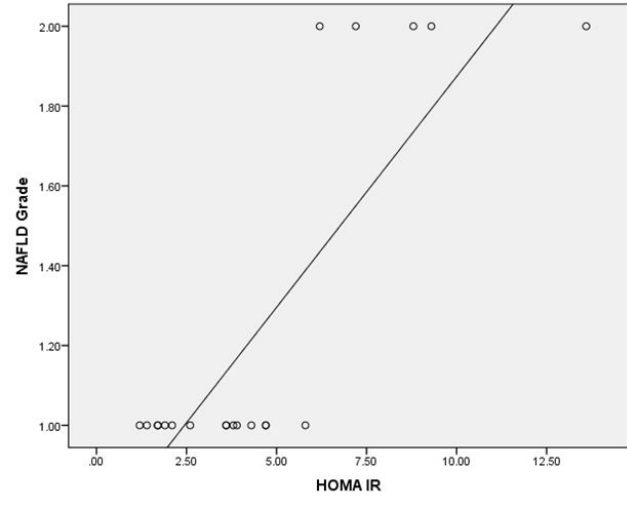
There was a statistically significant positive correlation between WHR and WHtR with fasting insulin with p-value <0.001, and r-value 0.889 and 0.925 respectively. Also there was highly statistical significant positive correlation

between WHR and WHtR with HOMA IR, with p-value <0.001 and r-value 0.886 and 0.925 respectively. DQG U YDOXH .

DQDO\VLV VKRZHG QR VLJQLILFDQWDFRGLVHODMELRQLRQKHO PRUH OLNHO  
\*UDGZHUH FRUUHODWHG ZLWK IDVWEDQHJXERLFFK OHYHPRUH JOLHO\ WR  
IDVWLQJ LQVXOLQ OHYHO PLX PO FRPSD+20\$ ,5 ZLWK WKH FVWVQHRXV ID  
SRSXODWLRQ WKHUH ZHUH QR VLJQLILFDQWFRULHODWLRQQRQHGMWZHHQ  
1\$)\' JUDGHV DQG IDVWLQJ JOXFRVH @YHO ZLWK U YDOXH  
DQG S YDOXH EXW WKHUH ZDV \$OVR KLJK VLJQLILFDQW SRVLWLYH  
FRUUHODWLRQ EHWZHHQ 1\$)\' JUDGHV IDVWLQJ JOXFRVH @YHO > @  
DQG +20\$ ,5 ZLWK S YDOXH DV VWRGLOLDOVWKHU VWXG\ SHUIRU  
ERIV WKDQ LQ JLUOV KRZHYHU WKH  
YV KRZHYHU LQ DQ ,WDOLDQ  
1\$)\' ZDV HTXDO LQ ERWK VHIHV > @  
ZDV QR VWDWLWVWLFDO VLJQLILFDQW  
JUDGHV DQG DJH RI WKH VWXG\ SRS  
UHVXOWV RI 3HQJ HW DO ZKLFK GR  
VLJQLILFDQW GLIIHUHQFH LQ DJH D  
1\$)\' VLPSON REHVLW\ JURXS VLPSON  
> @  
,Q WKLV VWXG\ WKHUH ZDV QR VWD  
EHWZHHQ 1\$)\' JUDGHV DQG ZW +W  
SRSXODWLRQ 2Q WKH RWKHU KDQG  
ZHUH VWDWLWVWLFDO\ VLJQLILFDQW  
GLIIHUHQW 86 JUDGHV IRU %0, DQG  
FRPSDULQJ WKH JURXSV ZLWK GLIIHU  
WKH 1\$)\' JURXS ZLWK JUDGH 86 IL  
VLJQLILFDQWO\ KLJKHU LQ UHIHUQF  
JUDGH 86 ILQGLQJ \$OVR WKH SDWL  
KLJKHU %0, %RG\ ZHLJKW PHDQ YDC  
SDWLHQWV ZLWK JUDGH 86 ILQGLQJ  
KLJKHU LQ SDWLHQWV ZLWK JUDGH  
> @  
\$OVR /HH HW DO VWDWHG LQ WKH  
PHDVXUHPHQWV LQFOXGLQJ KHLJKW  
VLJQLILFDQWO\ ZLWK KHSDWLF VWH  
VHHQ LQ WKH JURXS ZLWK PRUH VHY  
VWXG\ VKRZV FRUUHODWLRQ EHWZHH  
JOXFRVH IDVWLQJ LQVXOLQ DQG  
VWDWLWVWLFDO\ VLJQLILFDQW SRVL  
:+W5 ZLWK IDVWLQJ LQVXOLQ ZLWK S  
KLJKO\ VWDWLWVWLFDO VLJQLILFDQW  
DQG :+W5 ZLWK +20\$ ,5 ZLWK S YDO  
DOVR VKRZQ E\ 5 F W LDQX HW DO  
VWDWLWVWLFDO\ VLJQLILFDQW SRVL  
:+W5 ZLWK +20\$ ,5 DQG +20\$ ,5 LQFU  
ZLWK REHVLW\ JUDGH DQG ZLWK DE  
JUDGH +DQG +20\$ ,5@  
,Q WKLV VWXG\ WKHUH ZDV D KLJ  
DVVRFLDWLRQ EHWZHHQ 1\$)\' JUDGH  
SRSXODWLRQ LQGLQGHQW ZLWK FLUWV  
EHWZHHQ 1\$)\' JUDGHV DQG VHI RI W5H  
WKH RWKHU KDQG LQ PRVW VWXGLHV  
1\$)\' WKDQ JLUOV > @ ,Q VWXG\ \$GRYH  
LQFLGHQFH RI 1\$6+ LQ PDOHV ZDV  
IHPDOHVVV DQG JHQGHU ZDV D \$OVR  
1\$6+ DIWHU DGMXVWLQJ IRU DJH REH  
WKH PHWDEROLF V\QGURPH DQG LW  
7KH UHVWV IRU WKLV LVHSRWHV  
> @



)LJXU&RUUHODWLRQ EHWZHHQ V\$ LQ JUDGH DQG  
LQVXOLQ OHYHO



)LJXU&RUUHODWLRQ EHWZHHQ 1\$)\' JUDGH +DQG  
'LVFXVVLRQ

,Q WKLV VWXG\ WKHUH ZDV QR VWDWLWVWLFDO  
EHWZHHQ 1\$)\' JUDGHV DQG VHI RI W5H  
WKH RWKHU KDQG LQ PRVW VWXGLHV  
1\$)\' WKDQ JLUOV > @ ,Q VWXG\ \$GRYH  
LQFLGHQFH RI 1\$6+ LQ PDOHV ZDV  
IHPDOHVVV DQG JHQGHU ZDV D \$OVR  
1\$6+ DIWHU DGMXVWLQJ IRU DJH REH  
WKH PHWDEROLF V\QGURPH DQG LW  
7KH UHVWV IRU WKLV LVHSRWHV  
> @

ERIV WKDQ LQ JLUOV KRZHYHU WKH  
YV KRZHYHU LQ DQ ,WDOLDQ  
1\$)\' ZDV HTXDO LQ ERWK VHIHV > @  
ZDV QR VWDWLWVWLFDO VLJQLILFDQW  
JUDGHV DQG DJH RI WKH VWXG\ SRS  
UHVXOWV RI 3HQJ HW DO ZKLFK GR  
VLJQLILFDQW GLIIHUHQFH LQ DJH D  
1\$)\' VLPSON REHVLW\ JURXS VLPSON  
> @  
,Q WKLV VWXG\ WKHUH ZDV QR VWD  
EHWZHHQ 1\$)\' JUDGHV DQG ZW +W  
SRSXODWLRQ 2Q WKH RWKHU KDQG  
ZHUH VWDWLWVWLFDO\ VLJQLILFDQW  
GLIIHUHQW 86 JUDGHV IRU %0, DQG  
FRPSDULQJ WKH JURXSV ZLWK GLIIHU  
WKH 1\$)\' JURXS ZLWK JUDGH 86 IL  
VLJQLILFDQWO\ KLJKHU LQ UHIHUQF  
JUDGH 86 ILQGLQJ \$OVR WKH SDWL  
KLJKHU %0, %RG\ ZHLJKW PHDQ YDC  
SDWLHQWV ZLWK JUDGH 86 ILQGLQJ  
KLJKHU LQ SDWLHQWV ZLWK JUDGH  
> @  
\$OVR /HH HW DO VWDWHG LQ WKH  
PHDVXUHPHQWV LQFOXGLQJ KHLJKW  
VLJQLILFDQWO\ ZLWK KHSDWLF VWH  
VHHQ LQ WKH JURXS ZLWK PRUH VHY  
VWXG\ VKRZV FRUUHODWLRQ EHWZHH  
JOXFRVH IDVWLQJ LQVXOLQ DQG  
VWDWLWVWLFDO\ VLJQLILFDQW SRVL  
:+W5 ZLWK IDVWLQJ LQVXOLQ ZLWK S  
KLJKO\ VWDWLWVWLFDO VLJQLILFDQW  
DQG :+W5 ZLWK +20\$ ,5 ZLWK S YDO  
DOVR VKRZQ E\ 5 F W LDQX HW DO  
VWDWLWVWLFDO\ VLJQLILFDQW SRVL  
:+W5 ZLWK +20\$ ,5 DQG +20\$ ,5 LQFU  
ZLWK REHVLW\ JUDGH DQG ZLWK DE  
JUDGH +DQG +20\$ ,5@  
,Q WKLV VWXG\ WKHUH ZDV D KLJ  
DVVRFLDWLRQ EHWZHHQ 1\$)\' JUDGH  
SRSXODWLRQ LQGLQGHQW ZLWK FLUWV  
EHWZHHQ 1\$)\' JUDGHV DQG VHI RI W5H  
WKH RWKHU KDQG LQ PRVW VWXGLHV  
1\$)\' WKDQ JLUOV > @ ,Q VWXG\ \$GRYH  
LQFLGHQFH RI 1\$6+ LQ PDOHV ZDV  
IHPDOHVVV DQG JHQGHU ZDV D \$OVR  
1\$6+ DIWHU DGMXVWLQJ IRU DJH REH  
WKH PHWDEROLF V\QGURPH DQG LW  
7KH UHVWV IRU WKLV LVHSRWHV  
> @

5HODWLRQ EHWZHHQ VHYHULW\ RI 1\$)/' DQG LQVXOLQ UHVLVWDQFH LG

DJUHHPHQW ZLWK DQRWKHU VWXG\ JUDGHV DQG VLDWV DQVWLW S  
FKLOGUHQ ZLWK PLOG 1\$)/' " DQGV LJQLILFDQW VHG DV WKH GHJUHH R  
FKLOGUHQ ZLWK PRGHUDWH WR VHYHUHQV UHVLVWDQFH ZDV VWDWLVW  
2Q WKH RWKHU KDQG 6RQJ HW DO VLDWV VLPV DQG S  
UHSRUWHG WKDW KLV VWXG\ GLVFRYHUHG IDLU@FRUUHODWLRQ EHWZH  
:DLVW WR +HLJKW 5DWLR :+W5 DQG 5FRUPLDQV IDQVHQJ%JQXFRVH OHYHO  
VFRUH ZLWK &RQWUROOHG \$WWHQXSULRQDQV DQVWLWVHQJH&\$Q YDOLXG\UH  
ZKLFK LQGLFDWH KHSDWLF IDW GHSRQVZBRQRYUPODQV KFKLQV DO UDD  
RI WKHVH SDUDPHWHUV > @ 7KH UHQVHUHQV VFKLQGVKQZHG QZLWK \*  
VWDWLVWLFDOO\ VLJQLILFDQW DVVRFKDOV RQEHWZHHQKHS\$DVVFRGDWLRQ  
ERG\ FRPSRVLWLRQ DV UHJDUGV IDWYDQV DQG ERGKDLW DQDQDQVWR DO  
2SSRVLWH WR WKHVH UHVXOWV ZDV WKH VWDWV WKPWJDVWLQV  
3HQJ HW DO LQ WKLV VWXG\ ERG\ WKH WKUHQV XSVWKH 1\$)XGUDGHV  
VLJQLILFDQWO\ KLJKHU WKDQ LQ WKH 6LPSOH 6WHDWRVLV 66 DQG  
6LPSOH 2EHVLW\ 62% JURXS 3HUFHQWDJH RI ERG\ IDW LQ WKH 66  
DQG 1\$6+ JURXS ZHUH VLJQLILFDQWO\ KLJKHU WKDQ LQ WKH 62%  
JURXS EXW WKUH ZDV QR VLJQLILFDQW FRUHWHQVHQVWKH)LDV  
WZR JURXS LQGLFDWLQJ WKDW WKHVH WKZV DQWKUVRPHVWLFQFH  
PHDVXUHPHQWV FRXOG QRW ZHOORWKH VSHFWUXBLRHU  
1\$)/' > @ VFUHHQLQJ WRRO DQG DQ LPSRUWDQ

+RZHYHU WKH VWXG\ GRQH E\ 3URNR 1\$ZLVHWRO\$QFRKZGFDVLDWU\LYH  
UHVXOWV WR WKH FXUUHQW VWXG\ UHVXOWVGLVFDVPHVFRGLDWU  
" LQ SDWLHQWV ZLWK 1\$)LPSRUWDQW WR GHVWHFW HDUO\ VWH  
SDWLHQWV ZLWKRXW 1\$)/' ZLWK S 78% DQG ERG\ IDW  
DQDO\VLV LV " LQ SDWLHQWV ZLWK 1\$)/' DQG "  
LQ SDWLHQWV ZLWKRXW 1\$)/' ZLWK 5FRUPLDQV JPHQVXW KH  
VWDWV WKPW LQ JURXS GLIIHUHQW LQ IDW IUHH PDVW DQG WRB  
ERG\ ZDWHU 2EHVLW\ LQGLFDWLV UHVXOWV DUH WKDQVWRVWRWRH  
LQ WKH 1\$6+ JURXS ZHUH VLJQLILFDQWO\ KLJKHU WKDQ LQ WKH VLPSON  
VWHDWRVLV DQG VLPSON REHVLW\ JURXS > @  
5HIHUHQFHV

7KLV VWXG\ VKRZHG VWDWLVWLFDOO\ VLJQLILFDQW DVVRFKDOV GHW  
EHWZHHQ 1\$)/' JUDGHV DQG IDVWLQJ LQVXOLQV DQVWLWV DQVWLWV  
ZLWK JUDGH VWHDWRVLV KDG DEQRUPDQV DQVWLWV DQVWLWV SU  
DPRQJ WKRVH ZLWK JUDGH KDG DEQRUPDQV DQVWLWV DQVWLWV  
KDG QRUPDO YDOXHV VLPLODU UHVXOWV ZHUH GRFXPHQWV LQ RWKHU  
VWXGLHV RQ FRPSDULQJ IDVWLQJ LQVXOLQV DQVWLWV DQVWLWV DQVWLWV  
1\$)/' DQG WKH IRXQG VLJQLILFDQWO\ ERG\ DQVWLWV DQVWLWV (HW  
GLIIHUHQW JUDGHV DV IDVWLQJ LQVXOLQV DQVWLWV DQVWLWV DQVWLWV  
VWHDWRVLV ZDV DQG 8PHWLQGVKQZHG UHQVHUHQV  
1\$6+ > @ VLPLODU UHVXOWV ZHUH GRFXPHQWV DQVWLWV DQVWLWV DQVWLWV  
KLV VWXG\ ZKHQ FRPSDULQJ IDVWLQJ LQVXOLQV DQVWLWV DQVWLWV DQVWLWV  
JUDGHV RI 1\$)/' DQG KH IRXQG VLJQLILFDQWO\ ERG\ DQVWLWV DQVWLWV  
GLIIHUHQW JUDGHV > @ .DVVL ( 3HUYDQLGRX 3 .DQVWLWV

\$OVR WKLV VWXG\ VKRZHG KLJKO\ VWDWLVWLFDOO\ VLJQLILFDQW  
DVVRFKDOV EHWZHHQ 1\$)/' JUDGH DQG +20\$ ,5 ZKHUH DOO  
FKLOGUHQ ZLWK JUDGH 1\$)/' VKRZH 3HUYDQLGRX ,5 %HUHQVUHQV & \*QWK  
WKRVH ZLWK \*UDGH KDG QR ,5 DVVRFKDOV DQVWLWV DQVWLWV DQVWLWV  
DQG KDG VHYHU ,5 7KLV LQGLFDQW ERG\ DQVWLWV +20\$ ,5 LQ  
DQRWKHU VWXG\ LQ ZKLFK 1\$)/' ZDV 7KLV LQGLFDQW ERG\ DQVWLWV  
GLDJQRVHG LQ SDWLHQWV ZLWK +20\$ ,5 UHVXOWV DQVWLWV DQVWLWV  
YDOXHV WKDQ LQ FKLOGUHQ ZLWK WKH DEQRUPDQV DQVWLWV :RI +20\$ ,5\SHUD  
YV IRU +20\$ ,5! SHUYDQLGRX UHVLVWDQFH 7KH FKLHI  
+20\$ ,5 ! > @ ,Q DQRWKHU VWXG\ ERG\ DQVWLWV DQVWLWV DQVWLWV  
WKH +20\$ ,5 YDOXHV RI FKLOGUHQ ZLWK LQVXOLQV DQVWLWV DQVWLWV DQVWLWV  
VLJQLILFDQWO\ KLJKHU WKDQ WKRVH RKLWV DQVWLWV DQVWLWV DQVWLWV DQVWLWV  
WKH REHVH JURXS ZLWKRXW VWHDWRVLV DQVWLWV DQVWLWV DQVWLWV DQVWLWV

0HKWD 6. :DLVW FLUFXPIHUHQFH W R F & DLVW W V K Z N D D V W X F K L D G E H I Q W U D  
DQG DGROHVFHQWV &OLQ 3HGLDWU ZDLVW WR KHLJKW UDWLRV LQ 8. F  
0XQLDSSDHH 6 &KHQ + &XUUHQW W Z S S G R H B P R H V Y R S S R U W V W K H V L P S  
D V V H V V L Q J L Q V X O L Q V H Q V Q W Y Y Y W F L D Q S P I U H W I Q F M D W R H O H V V , Q A R E E A V K I  
\$G Y D Q W D J H V O L P L W D W L R Q V D Q G D S S U R S U L D W H X V D J H \$ P -  
3K\VLRO (QGRFULQRO 0HWDE 0D I H L W D Q J B W R O D P L Q E H V L W \ V W X G  
&DOJD D L O O G D P V / \$ 7 K H Q D W X U D O W F R H W D V L R P L H W Q R I S H G L D W U L F  
DOFRKROLF IDWW\ OLYHU GLVHDVH G L W E H V R P O R F L : D L V W W R K H L J K W U  
+X D Q J - 6 % D I X Q B E V 6 K M H H W U D O & K L O G K R R G P H W D E R O L F U L V N L Q H R Y D W Z H L  
R E H V L W \ I R U S H G L D W U L F 3 H G L D W W R H Q W H J R R J L V W V -  
\*D V W U R H Q W H U R O 1 X W U 0 D W W K H Z R V S H X G H S S N H W D O + R P I  
3 D S D Q G U H . P X D E R X V D Q W R O H R Q W D O P R G H O D V V H V V P H Q W , Q V K O O Q I X Q F  
, Q Y H V W L J D W L R Q R I D Q W K U R S R P H W U L F P E L D V K H P L S O D V P D J O L X F W Y U \ D G  
S D U D P H W H U V R I R E H V H F K L O G U H Q P D L W K L D E H V R Z L W K R X W Q R Q  
D O F R K R O L F I D W W \ O L Y H U G L V H D V H \$ S S A R R S S N K R X U L & D U W H U . H Q W &  
< R X Q R V O L . R H Q L J \$ S S H O D W L I O R E D O 8 O W U D V R Q R X U D S K L W D W L Y H H V W L P  
H S L G H P L R O R J \ R I Q R Q D O F R K R O L F I D W W \ O L Y H U G L V H D V H P H R G D O F R K  
D Q D O \ W L F D V V H V V P H Q W R I S U H Y D O S H Q F H - 3 H G F E D W H Q F H D V W B R G Q W H U R O  
R X W F R P H V + H S D W R O R J \ \$ Q G H U V R Q ( / + R Z H / ' - R Q H V + ( H  
% X J J H V W Q J D Q Z V R F K D V J L K H P X O W L S B H R R Q D O F R K R O L F I D W W \ O L Y H U  
S D W K R J H Q H V L V R I 1 R Q \$ O F R K R O L F D G B O W F H L W H Y \$ L V H D W H P D W L 3 F O R G Y  
1 \$ ) / ' 0 H W D E R O L V P R Q H H  
' R Z P D Q 7 R P O L Q V R Q - : 1 H Z V R P H 3 1 : L H D Q G H Q O V L V H D O H W D O 2 E H V H  
R I Q R Q D O F R K R O L F I D W W \ O L Y H U G L V H D V H S U L V N I R U Q R Q D O F R K R O  
R Y H U Z H L J K W R U R E H V H , K A W O G

2]K D % Q U V R % . L U H P I 6 W H L W D O , Q V X O L Q 2 E H V  
L Q G L F H V Y Y D O W L R O V H V W L P X O D W H G O G S E P H Y E Q - K R Y L D W H W F D O & O L Q L F  
Q R Q D O F R K R O L F I D W W \ O L Y H U G L V H D V H M N I D F W R U V R I Q R Q D O F R K R O L F  
6 F L Z L W K R E H V L W \ % 0 & 3 H G L D W U  
& L E D L G K D O P 7 K H D V V R F L D W L R Q E H W Z H H Q Q R Q D O F R K R O L F 7 H O O K X U D N U H G L F  
I D W W \ O L Y H U G L V H D V H D Q G L Q V X O L Q Y D O X H R I V W D L O F H L W \ O H R E H V P H W  
F K L O G U H Q D Q G S F D V R I O G H L F W Q M F D U H V L V W D Q F H I R U W K H U L V N R I Q R  
G L D J Q R V L V L Q R E H V W W R O R G W H O R G

9 R 0 % \$ E U D P V 6 + % D U O R Z 6 ( H W D O 1 \$ 6 3 \* + \$ 1  
F O L Q L F D O S U D F W L F H J X L G H O L Q H I R U W K H G L D J Q R V L V L W D S E G Q D W D P H Q  
R I Q R Q D O F R K R O L F I D W W \ O L Y H U V G L W M B R I S W M S X F K L V G G H Q \$ S R V V  
5 H F R P P H Q G D W L R Q V I U R P W K H ( [ S H U W Q X P L W W H L V R D Q S H ' 2 E H V L W \  
( & 2 1 D Q G W K H 1 R U W K \$ P H U L F D Q S R I V L R V M H I O N B Y L W H G L F W R ' 6 W R M D G  
\* D V W U R H Q W H U R O R J L D \ + H S D W R O R J L D 1 X W U L V E R Y O L W \ D Q G P H W D E R O L F V I Q G U R I  
1 \$ 6 3 \* + \$ 1 3 H G L \* D W W U R H Q W H U R O G H Y H O R S P H Q W R I Q R Q D O F R K R O L  
G L D J Q R V H G E I 9 K O O R V D V R K O G

7 H P S O H - / & R U G H U R 3 / L - H W D O \$ J X L G H W R Q R Q D O F R K R O L F  
I D W W \ O L Y H U G L V H D V H L Q , K W R O G K R R I G H D O H R O G R O K D M H Q F H W K H D S S U R S  
6 F L G L D J Q R V L Q J 1 \$ ) / ' X V L Q J X O W U D V  
% H U J L S R E W D L O G H , P S D F W R I R E H V L W \ F K G G L U H Q ' R U O G - 3 H G L D W U  
U H V L V W D Q F H R Q F L U U K R V L V D Q G 5 F S M U N D O K I D R K S R O W E R O F H W Q D O , Q V  
\* D V W U R H Q W H U R O R J L D \ + H S D W R O R J L D E H W Z H H Q P H W D E R O L F D Q G W K I U P  
% H G R J O L V W D S G B Q O R H W D O 5 H O D V L S E X E D V K L S  
E H W Z H H Q I D W W \ O L Y H U D Q G J O X F R V H V P H W D E R O L F W D \$ O F O R F D % H O J L  
V H F W L R Q D O V W X G \ L Q R E H V H 6 R K L G E U H Q J + & W U L W & R O W D O 3 H  
P H W D E R O L V P D Q G F D U G L R Y D V F X O D U I D V W H D O H V H U G L V H D V H S U H G L F W H  
) L U G R X V 6 / R G K L O 2 W D L O G L F K H W H U H Q V K U R X J K 3 W O D W Q R B H O O S D W U  
O H Y H O V D W G L I I H U H Q W Z D L V W W R K L S U D W L R V D P R Q J Q R U P R W H Q V L Y H  
R Y H U Z H L J K W D Q G R E H V H S D W R O W \$ P L Q S L O O \$ P V W X Y ' - ( O U L I D H \ 6 F  
3 K \ V L F L D Q V 6 X U J 3 D N O H Y H O V L Q F K L O G U H Q Z L W K Q R Q D  
3 H G L D W U \* D V W U R H Q W H U R O 1 X W U



5HODWLRQ EHWZHHQ VHYHULW\ RI 1\$)/' DQG LQVXOLQ UHVLVWDQFH LG

6KDVK MLQR 5 &RQWROL % HW DORUWVSRQGHQFH QPHJWR RI  
+20\$ ,5 LQ QrupDO ZHLJKW DQG REHVH \RXQJ &DXFDVLDQV  
\$FWD GLDEHWRORJLFD + (O .KD\DW

7RUXQ ( g]JHQ ,7 \*|NoH 6 HW DO'HZHUWPHQRURRORRHHOHDMDV  
LQ REHVH FKLOGUHQ DQG DGROHVHQWY ZLWK QRO DOFRKROLF IDWW\  
OLYHU GLVHDVH - &OLQ 5HV 3HGLDWU (QGRFULQRO

&DLUR (J\SW  
6KDUDI 0\$ +DVKHP +( \$KPHG :2 6LPXOWDQHRXY XYH RJ  
IDFWRU [LLL DQG ILEULQ GHJUDGDWLRQ SURGXFWV LQ GLDJQRVLQJ  
HDUO\ FDVHV RI QHF DQG QHRQDWHO 6(36,6 -RXUQDO RI  
6FLHQWLILF 5HVHDUFK LQ OHGLFDO DQG %LRORJLFD 6FLHQFHV